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PHYSICS.—*Glaser's experiments and the orientation of molecules in a magnetic field.* G. BREIT, Carnegie Institution of Washington. (Communicated by L. A. BAUER.)

It has been shown by Glaser that the diamagnetic susceptibility of H_2, N_2, CO_2 is proportional to the pressure for sufficiently high pressures, but that at a certain pressure [in the particular experiments about $\frac{1}{10}$ atmosphere] another non-linear law is followed. At sufficiently low pressures the susceptibility is again proportional to the pressure. Glaser and Debye suggest that the transition region is due to the finite time which is required for the establishment of space quantization.[1,2,3] Without discussing the mechanism which orients the molecules, we can derive some restrictions as to the laws which govern this phenomenon. These restrictions are discussed below with the conclusion that some of the apparently simplest laws may contradict Glaser's results, while others are in agreement with them.

We begin by supposing that every collision destroys the orientation of a molecule. We consider the time $t = 0$ as representative of the general state, and we approximate the relative number of molecules, which have suffered a collision for the last time t seconds before $t = 0$, by $e^{-\frac{t}{T}} d\left(\frac{t}{T}\right)$ where T is a constant for a given pressure. This group at the time $t = 0$ consists partly of oriented and partly of unoriented molecules.

Our first hypothesis is that the number of molecules which are not oriented at $t = 0$ is $e^{-\frac{t}{\tau}}$. Denoting the specific susceptibility by χ and using suffixes Q, C to denote quantum and classical values of χ

[1] Glaser, Ann. der Physik, **75**: 459. 1924.

[2] Debye, P., Amer. Physic. Soc. Bull., Feb. 14, p. 8, 1925.

[3] A different interpretation of the mechanism of passing into the oriented condition is contained in Rvark and Breit, Phil. Mag. **59**: 504. 1925.

[corresponding to the oriented and unoriented condition respectively] we have

$$\chi = \int_0^\infty \left[\chi_e\, e^{-\frac{t}{\tau}} + \chi_Q\,(1 - e^{-\frac{t}{\tau}})\right] e^{-\frac{t}{T}} d\left(\frac{t}{T}\right) = \frac{\frac{\tau}{T}\chi_e}{\frac{\tau}{T}+1} + \frac{\chi_Q}{\frac{\tau}{T}+1} \quad (1)$$

The absolute (volume) susceptibility κ may be written as $\kappa = k\chi/T$ for a given temperature, k being a constant, as long as the gas is not too dense. Hence

$$\kappa = \frac{k\chi}{T} = \frac{\frac{\tau}{T}\kappa_e + \kappa_Q}{\frac{\tau}{T}+1} \quad (2)$$

where

$$\kappa_e = \frac{k}{T}\chi_e,\ \kappa_Q = \frac{k}{T}\chi_Q.$$

Taking in accordance with Glaser $\chi_Q = 3\chi_e$ and letting

$$\kappa_0 = \frac{k}{\tau}\chi_e,\ x = \frac{\tau}{T} \quad (3)$$

we have

$$\kappa = x\left(1 + \frac{2}{1+x}\right)\kappa_0 \quad (4)$$

Here x is proportional to the pressure and we may compare (4) directly with Glaser's curves. It is seen that the asymptote to (4) does not pass through the origin (curve 1) and that the point of inflection characteristic of Glaser's curves is absent in (4). Thus Glaser's results show the probabilities of orientation are not given by a simple exponential relation.

We investigate next in what manner the function $e^{-\frac{t}{\tau}}$ should be changed in order to give such a dependence of κ on x that the asymptote should pass through the origin. We suppose that the probability of an atom being unoriented a time t after a collision is $\left(\frac{t}{\tau}\right)$ where τ is constant for a given magnetic field. We have

$$\chi = \int_0^\infty \left[\chi_c f\left(\frac{t}{\tau}\right) + \chi_Q \left\{1 - f\left(\frac{t}{\tau}\right)\right\}\right] e^{-\frac{t}{T}} \left(d\,\frac{t}{T}\right) \qquad (5)$$

and

$$\kappa - \kappa_c = \kappa_o \left(\frac{\chi_Q}{\chi_c} - 1\right) x \int_0^\infty \left[1 - f\left(\frac{t}{x}\right)\right] e^{-t}\, dt \qquad (6)$$

We wish that $\kappa - \kappa_c$ should vanish for large x. This means that the integral in (6) must vanish faster than $\frac{1}{x}$. Since x is large we are only concerned with values of f for small values of the argument, and we have therefore the condition that $1 - f(y)$ for small y must vanish faster than y. The physical meaning of this is that the number of molecules in an oriented state at time t, since the group considered suffered a collision, must for small t vanish faster than t. Since τ must be supposed to depend on H and since small values of H give large values of τ we have another physical interpretation, viz., that in weak fields the number of oriented atoms at a given time t since the last collision must vanish faster than $\frac{1}{\tau}$. How τ depends on H cannot be said without forming a hypothesis as to the mechanism which establishes the orientation. However, experiments on the variation in Glaser's curves with H will surely establish the nature of this relationship.

Experiments on resonance radiation may be interpreted in terms of the dependence of τ on H. Thus it is known that if the polarization of resonance radiation in a field H be P, then $\left(\frac{dP}{dH}\right)_{H=0} < 0$. The depolarization of resonance radiation on our hypothesis is mainly due to the presence of atoms which have acquired their final orientation in the magnetic field. For weak fields at the mean instant of falling from the excited to the unexcited level the number of "depolarized" atoms is proportional to $1 - f\left(\frac{t_o}{\tau}\right)$ where t_o is the *mean* life of the atom. Now this number for large τ is of the form $\left(\frac{t_o}{\tau}\right)^{1+\delta}$ where $\delta > 0$ or else it vanishes still more strongly than that. If τ should be inversely proportional to H, then P for small H would be approximately proportional to $H^{1+\delta}$ and $\left(\frac{dP}{dH}\right)_{H=0}$ would vanish as H. It seems probable

therefore that τ has the character of H^{-q} where q is a proper fraction $(0 < q < 1)$ for then $\frac{dP}{dH}$ is proportional to $H^{q+q\delta-1}$ which does not vanish if $q = \frac{1}{1+\delta}$. In particular we note that if $\delta = 1$, then $q = \frac{1}{2}$. We shall see presently that $\delta = 1$ is in fair agreement with Glaser's results, and we consider therefore the physical significance of $q = \frac{1}{2}$.

If an atom behaves as a magnetic doublet of fixed moment the magnetic field H exerts a moment on it which is proportional to H, and if during the orienting process the field exerts a sensibly constant moment, a given angle θ is passed in a time τ_o such that

$$\theta = A H \tau_o^2$$

where A is constant. This explains why the time constant τ may be taken to be $\backsim \frac{1}{\sqrt{H}}$ because it is reasonable to suppose that a certain angle must be turned through in order to assume the final orientation. Needless to say, the relation $\tau \backsim \frac{1}{\sqrt{H}}$ is not the only possible one. However, the writer thought it of interest to show that the restrictions on f are not of such a nature as to be inconsistent with experiments on the depolarizing influence of a magnetic field on resonance radiation. The question of the magnitude of θ in the above formula we leave open. A closer examination of numerical values shows that it may be roughly the ratio of the period of the electron to the mean life of an atom. We have proved that for small y the function $1 - f(y)$ must vanish more strongly than y. In our proof it has been assumed that the number of molecules which, when referred to $t = 0$, have suffered their last collision in the interval of time $-t$, $-t + dt$ is $Ne^{-\frac{t}{T}} d\frac{t}{T}$ where N is the total number of molecules. Let us suppose now more generally that this number is $N\varphi\left(\frac{t}{T}\right)d\left(\frac{t}{T}\right)$. We have

$$\int_o^\infty \varphi\left(\frac{t}{T}\right) d\left(\frac{t}{T}\right) = 1 \qquad (7)$$

and in place of (6) we obtain

$$\kappa - \kappa_o = \kappa_o \left(\frac{\chi_Q}{\chi_o} - 1\right) x \int_o^\infty \left[1 - f\left(\frac{t}{x}\right)\right] \varphi(t) dt \qquad (8)$$

Again the experimental results require that the integral should vanish more rapidly than $\frac{1}{x}$ if x is large. If now for small y the function $1 - f(y)$ vanishes as y the integral in (8) cannot vanish faster than $\frac{1}{x}$ unless $\int_0^\infty t\varphi(t)dt$ vanishes. However, this integral cannot vanish because both t and $\varphi(t)$ are positive by definition throughout the range of integration. Thus our conclusion as to the behavior of $1 - f(y)$ at $y = 0$ is independent of the form of ϕ as long as this form is in the range of physically possible forms. If $\int_0^\infty t^q\varphi(t)dt$ should be divergent for $q > q_0$, we have the additional requirement that $1 - f(y)$ should vanish more rapidly than y^{q_0}.

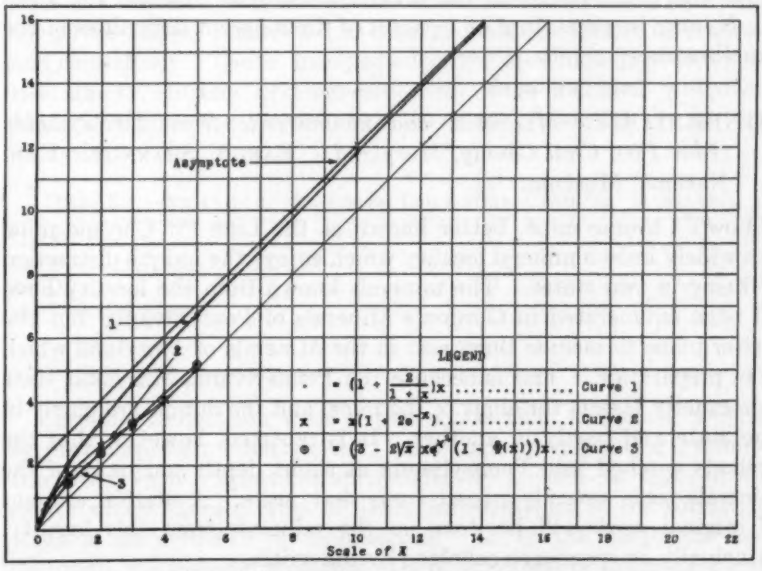

Fig. 1.—Theoretical dependence of susceptibility on pressures

Using special forms of f which satisfy the derived condition and making $\varphi(y) = e^{-y}$,

(1) If $f(y) = 1$, $(0<y<1)$; $f(y) = 0$ $(1<y<\infty)$ we have

$$\kappa = \kappa_0 x\left[1 + \left(\frac{\chi_0}{\chi_\infty} - 1\right)e^{-x}\right]$$

(2) If $f(y) = e^{-y^2}$ we have

$$\kappa = 2\kappa_0 \cdot y\left[\frac{\chi_Q}{\chi_c} - \left(\frac{\chi_Q}{\chi_c} - 1\right)\sqrt{\pi}\, y\, e^{y^2}(1 - \Phi(y))\right]$$

where

$$y = \frac{x}{2}, \Phi(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-x^2}dx$$

For the case $\chi_Q = 3\chi_c$ these relations are plotted as curves 2 and 3. The first is plotted against x and the second against y. It is seen that the reproduction of the shape of Glaser's curves is fair. Glaser's relation for CO_2 appears to follow a somewhat different law, though an inquiry into the nature of the difference between CO_2 and the gases H_2, N_2 may be premature on account of the inherent difficulties of the experiments.

MINERALOGY.—*Magnesite and kammererite from Low's Mine (Line Pit), Cecil County, Maryland.*[1] EARL V. SHANNON. U. S. National Museum.

Low's Chrome mine, better known as the Line Pit Chrome mine is a widely known mineral locality which enjoys the unique distinction of being in two states. The minerals known from the locality have all been enumerated in Gordon's Minerals of Pennsylvania[2] but the writer plans to include them also in the Minerals of Maryland which is in preparation. This is because the Pennsylvania-Maryland state line exactly bisects the shaft of the mine, and the dumps are partly in one state and partly in another. It is reported, however, that the orebody pitched into Pennsylvania at slight depth and most of the minerals were actually mined from that state. A certain amount of original work will be done on the minerals from this locality, principally on specimens collected by the writer.

MAGNESITE

A specimen of magnesite has recently been analyzed in the Museum laboratory and, since no analysis of this carbonate is recorded from this mine the following short description is presented. The specimen,

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] Samuel G. Gordon, *The Mineralogy of Pennsylvania*, Acad. Nat. Sci., Philadelphia, Special Publication No. 1, 1922.

when picked up on the dump of the mine, weighed 4 or 5 pounds. It consisted of a flat slab, about 4 centimeters in average thickness and apparently represented the full width of a narrow vein. On one wall is a layer up to 1 centimeter wide consisting of serpentine (williamsite) in thin flakes surrounded by white magnesite. On the other wall is a layer of similar thickness of pale brown material, mottled with white spots. The central part of the mass is a vein 2 centimeters in average thickness of white material of porcellanous appearance, containing scattered open spaces a millimeter or two in diameter. This central vein is bordered on either side by a crust from 1 to 3 millimeters thick of grayish translucent material.

The specimen appears anything but homogeneous. Mr. Gordon, who was with the writer when it was collected, ventured the opinion that the material was a mixture of magnesite and sepiolite, while the writer himself regarded it as most probably a mixture of magnesite and chalcedony. Quite unexpectedly, the specimen proved to consist almost entirely of magnesite with some included williamsite. Material from the central vein gave the following results upon analysis:

TABLE 1.—ANALYSIS OF MAGNESITE, LOW'S MINE, CECIL CO., MARYLAND

$MgCO_3$	96.26
$CaCO_3$	2.50
$FeCO_3$	0.58
Insoluble and silica	0.28
	99.62

Careful examination with a lens shows that the whole specimen seems to represent open cavities. Although the serpentine is minutely fractured, each fragment is surrounded by a clean-cut layer of magnesite which forms a crust of fibers perpendicular to the surface and there is no evidence of replacement. All of the magnesite has a decidedly chalcedonic structure and is composed of layers and crusts of fine fibers in the arrangement commonly regarded as indicating that the material is a metacolloid, i.e., has originated by the crystallization of an amorphous material. In the present case, as has been suggested for other occurrences of magnesite, this structure might have been inherited from hydromagnesite after which the magnesite may be secondary.

The thin sections show the same characters observed in the grains. The brownish material which makes up one wall of the central portion

of the vein is colored by a minute amount of deweylite which, under the microscope, shows a fine metacolloidal structure and low birefringence coupled with low refractive index. It is the latest mineral deposited in the cavities. Minute amounts of deweylite may account for the silica shown by the analysis.

Another specimen from this locality shows small globular masses of magnesite made up of loose concentric shells or hollow hemispheres of magnesite up to 5 millimeters in diameter. These are pale brownish white in color and have the dense appearance of chalcedony, from which they are distinguished by their softness. The magnesite rests upon a base of williamsite. A third specimen of kammererite bordering chromite has a fibrous texture and is fractured and the fractures are filled with thin seams of magnesite.

Gordon[3] mentions magnesite from this locality as follows: "magnesite was quite common at a depth of 60 meters, forming thick veins cutting more or less horizontally across the orebody and the serpentine; which circumstance throws some doubt on the belief that magnesite is a product of surface solutions, causing the pendulum of modern paragenetic thought to swing still further and include even magnesite in the category of minerals produced by hydrothermal solutions."

The writer is strongly inclined to support Gordon in his belief that this magnesite is a product of hydrothermal solutions rather than surface-weathering, downward-percolating carbonated solutions of meteoric water. The specimens here examined are very clearly fissure fillings in cracks which seem to have been repeatedly reopened. There is no evidence of metasomatic replacement of the serpentine in the examples studied.

Kammererite

Although a total of seven analyses of penninite containing some chromicoxide, most of them of the pink material usually designated kammererite, from Wood's chrome mine in Lancaster County, Pennsylvania, are quoted by Gordon,[4] he gives no analysis of this mineral from the Low mine in the same region which probably indicates that the mineral from this mine has never received a detailed examination. The writer therefore presents the following short description of a

[3] Samuel G. Gordon, *Texas, Lancaster County, Pennsylvania*, Amer. Mineralogist, 6: 115. 1921.

[4] Samuel G. Gordon, *The Mineralogy of Pennsylvania*, Acad. Nat. Sci., Philadelphia, Special Publication No. 1, 1922.

specimen collected at the Line Pit, as the mine is commonly known, and examined in the Museum laboratory.

The specimen was collected from a pile of chromite mined during the war period of 1917 when this mine was reopened. It consists of a mass of chromite bordered on one side by a sheet of the kammererite varying in thickness up to 1 centimeter. The color of this mineral ranges from dark bluish-purple to purplish-white. The difference in color coincides with a difference in translucency, the darkest material being very translucent while the lightest appears almost opaque on polished surface. The translucency, in turn, is dependent on the presence or absence of air inclusions which render the chlorite opaque. The structure of the chlorite is compact; it shows no micaceous cleavage but only a rectangular parting with splintery fracture and fibrous appearance with silky luster. The texture is that described for the material from Lake Itkul, Siberia, to which the name rhodochrome was given. The chlorite is intimately fractured and the fractures are filled by thin veins of magnesite, less than half a millimeter in width.

TABLE 2.—ANALYSIS OF KAMMERERITE, LOW'S MINE, CECIL CO., MARYLAND

SiO_2	32.28
Al_2O_3	10.64
Fe_2O_3	1.04
Cr_2O_3	2.74
FeO	0.96
CaO	0.06
MgO	38.14
H_2O above 120°C	14.84
H_2O below 120°C	none
Total	100.70

The sample analyzed was ground, and freed from some included chromite and a considerable amount of magnesite by the use of heavy solutions. The analysis gave the results shown in Table 2. This composition is very similar to the average of published analyses of penninite, the chromium content not being very large as compared with other kammererites which have been analyzed. The ratios do not yield any simple formula, the analysis being represented fairly well by the formula $7MgO \cdot Al_2O_3 \cdot 4SiO_2 \cdot 6H_2O$.

Under the microscope the analyzed powder is practically colorless and hence no pleochroism is observable. The optical properties are very difficult to determine but seem to agree with those of penninite. Plates parallel to the basal cleavage are dark in all positions be-

tween crossed nicols and are probably essentially uniaxial with the acute bisectrix perpendicular to the cleavage. No definite interference figure could be observed although, in convergent light, there is a suggestion of strong dispersion. Many of the grains are clouded with opaque air inclusions. Plates on edge show very low birefringence with sub-normal low order blue interference colors. The index of refraction of basal plates ω, is about 1.570. It seems probable that the low birefringence, high dispersion, and confused optical figure are due to complex twinning, a characteristic of penninite.

Other specimens from this locality, not yet studied in detail, consist of pale violet micaceous scales of chromiferous chlorite greatly resembling lepidolite, and still others contain compact pale purple material mixed with picrolitic sheared serpentine.

ENTOMOLOGY.—*New termites from the Solomon Islands and Santa Cruz Archipelago—II.*[1] THOS. E. SNYDER. Bureau of Entomology.

Family *TERMITIDAE*

Genus *Nasutitermes* Banks (sens. lat.)

Subgenus *Nasutitermes* Holmgren (sens. str.)

Species of the subgenus *Nasutitermes* Holmgren (sens. str.) have a wide distribution throughout the tropics of the world; they occur as far north as Mexico and the Bahamas and in the United States there is a doubtful record from Texas. Southward, *Nasutitermes* occurs in South America, Africa, Madagascar, Asia, New Guinea, Oceania generally, and Australia.

More species are included in this subgenus than in any other genus or subgenus of termites, approximately 200 having been described, nearly one-half of which are American. As a rule, species of *Nasutitermes* are quite distinct, although there are certain natural groups in which the species are of especially close relationship.

The soldier secretes a sticky fluid from the nasus which is a very effective defence against ants; in some species the workers bite viciously. These termites live in carton tree nests, in colonies in wood, and in the ground; they are destructive wood-borers.

Large queens of the first form of two species of *Nasutitermes* (sens. lat.) were found later on Guadalcanar Island, Solomon Islands, by Mr. Knibbs, Government Surveyor, and given to Doctor Mann: one species with a large eye and ocelli close to the eye, the other with a smaller eye and more distant ocelli. Of the latter species there were, in addition to the large first form queens, many smaller queens of the second form, with wing pads

[1] See this JOURNAL 15: 395–407. 1925.

varying in length from normal to as long as those of the nymphs of the first form; i.e., there was a large series of "intermediates." These specimens are in the United States National Museum.

It was believed at first that *Nasutitermes* (*Grallotermes*) *oceanicum* Snyder was in this subgenus, but the elongate third segment of the antenna and the long legs lead me to place *oceanicum* in the subgenus *Grallotermes* Holmgren. However, *oceanicum* has also been compared with the descriptions of all species of *Nasutitermes* (sens. str.) and may be in this subgenus, in the *matangensis* group (Haviland).

Subgenus *Grallotermes* Holmgren

Only five species in this subgenus are known, all of which occur in the oriental region. They are distributed as follows: Philippine Islands (2), Carolina Islands (1), New Guinea (1), and India (1). The soldiers are dark colored and long-legged, and have points to the mandibles. The worker has the post-clypeus bulging (arched) and less than half as long as wide. The winged sexual forms have the antenna with 15 segments, and large, prominent eyes.

Nasutitermes (*Grallotermes*) **oceanicum**, new species.

Soldier.—Head castaneous-brown (lighter posteriorly, where rounded); pear-shaped; in profile head with nasus forming a slight curve, but is in nearly a straight line; head with two transverse rows of long hairs, one anteriorly and one posteriorly, also microscopic hairs. Mandibles with fairly long sharp points at apex.

Nasus same color as head, but with slight reddish tinge at apex, lighter at middle, elongate, aquiline, broad at base, pointed at apex where slightly turned down, and beset with hairs.

Antenna yellow to light yellow-brown, with 13 segments; segments becoming longer and broader toward apex, with long hairs; third segment elongate, subclavate, slender, much longer than either second or fourth segments, sometimes twice as long; second and fourth segments subequal, or fourth longer than second; last segment shorter, slender, subelliptical.

Pronotum light yellow brown (darker at anterior margin), saddle-shaped, semicircular, inclined anteriorly, not or only slightly emarginate anteriorly, there provided with hairs.

Legs tinged with yellow, elongate, slender; hairs long.

Abdomen with tergites light yellow-brown; tergites with short hairs and a row of long hairs at base of each; sternites with dense long hairs; cerci elongate, prominent.

Measurements.—Length of entire soldier, 4.1–4.2 mm.; length of head with nasus, 1.85–1.9 mm.; length of head without nasus (to anterior, to base of mandibles), 1.05–1.1 mm.; length of nasus, 0.8 mm.; length of pronotum (where longest not at median), 0.25 mm.; length of hind tibia, 1.35 mm.; width of head posteriorly (where widest), 1.05–1.1 mm.; height of head at middle, 0.65 mm.; width of pronotum, 0.55 mm.

Nymphs of sexual form (with long wing pads) with large eye 0.32 mm. in length; antenna with 15 segments; third segment shorter than second or fourth; pronotum emarginate posteriorly.

Worker large, 5 to 5.5 mm. in length; head dark castaneous brown; Y-

suture distinct; antenna with 14 segments; post-clypeus bulging, length less than half its width.

Type locality.—Graciosa Bay, Santa Cruz Archipelago.

Described from a large series of soldiers collected with nymphs of the sexual form and workers at the type locality by Dr. W. M. Mann in July, 1916.

Type,[2] *soldier.*—Cat. No. 15293, Museum of Comparative Zoology, Cambridge, Mass.; paratype in U. S. National Museum.

Subgenus *Subulitermes* Holmgren

Species of the subgenus *Subulitermes* are few in number (only 15 have been described) and are restricted to the tropics of America, Africa, Asia, and Oceania. These termites range as far north as Panama in Middle America.

Winged adults of but very few species are known. In some species the number of antennal segments of the nymphs of the sexual forms has been noted in publishing the descriptions of the soldier and worker castes.

In the three new forms here proposed from the South Seas the nymphs of the sexual winged adults or the winged adults have 13 segments to the antenna and the soldiers 11 segments, while most of the previously described species from the oriental region have more segments to the antenna in both these castes.

Nasutitermes (*Subulitermes*) **orientis**, new species

Winged adult.—Head very dark reddish castaneous brown (lighter near eyes and posteriorly and anteriorly), not much longer than broad, suboval, punctate, with dense hairs, a few longer than the others. Fontanelle a hyaline, narrow, elongate, subelliptical slit ending in a raised spot at epicranial suture, posterior to ocelli. Eye black, not round, projecting, close to lateral margin of head. Ocelli hyaline, raised, suboval, separated from eyes by a distance less than their diameter.

Antenna dark brown; with 13 segments, the segments becoming longer and broader toward apex; third segment slender, subclavate shorter than second or fourth segment; fourth shorter than second segment; last segment slender, elongate, subelliptical.

Pronotum same color as head, nearly straight anteriorly (broadly and shallowly concave); posterior margin acutely emarginate; sides narrowed angularly to the posterior margin; hairs dense and long.

Wings dusky grayish; costal area yellow-brown (darker); tissue and margins hairy; in fore wing, median vein close to cubitus, in about middle of wing, branches to apex; hyaline area between median and cubitus; cubitus with 7–9 branches or subbranches to lower margin, not reaching apex.

Legs yellow-brown (the tibiae darker), elongate, slender; hairs long.

Abdomen with tergites reddish brown, slightly lighter colored than head, with dense long hairs, those at base of tergites longest; cerci prominent, broad at base, fairly elongate.

Measurements.—Length of entire winged adult, 9.5 mm.; length of entire deälated adult, 6 mm.; length of head to tip of labrum, 1.2 mm.; length of

[2] No definite specimen designated as holotype; hence, since the specific descriptions were made from a series, these are cotypes.

pronotum, 0.6 mm.; length of fore wing, 7.75 mm.; length of hind tibia, 1.1 mm.; diameter of eye (long diam.), 0.3 mm.; width of head (at eyes), 1.05 mm.; width of pronotum, 0.85 mm.; width of fore wing, 2.25 mm.

The winged adults of very few species of *Subulitermes* are known; *N.* (*S.*) *orientis* is a dark-colored, hairy-headed species, with antenna of but 13 segments.

Soldier.—Head yellow-brown or light castaneous brown (darkest on sides, lighter posteriorly and anteriorly), pear-shaped, slightly constricted in middle, rounded posteriorly; in profile head and nasus forming approximately a straight line; head with dense short hairs and scattered long hairs (3–4 rows). Mandibles without points at apex, or a minute, very short, sharp point in some specimens.

Nasus reddish brown, elongate, slender, cylindrical; hairs short.

Antenna light yellow-brown, with 11 segments; segments becoming longer and broader toward apex, with long hairs; third segment subclavate, subequal in length to second and fourth segments, but more slender; last segment suboval, slender.

Pronotum light yellow (margins darker), saddle-shaped, with short hairs and also long hairs on anterior margin, very slightly, emarginate (roundly and shallowly) anteriorly.

Legs tinged with yellow; elongate; slender; hairs long.

Abdomen tinged with yellow; tergites with dense long hairs, the longest row at base of each; cerci fairly elongate and prominent.

Measurements.—Length of entire soldier, 3–3.3 mm.; length of head with nasus, 1.3 mm.; length of head without nasus (to anterior), 0.8 mm.; length of nasus, 0.5 mm.; length of pronotum, 0.15 mm.; length of hind tibia, 0.67 mm.; width of head posteriorly (where widest), 0.8 mm.; width of pronotum, 0.4 mm.

Worker.—Post-clypeus not as long as half its breadth.

Type locality.—Auki, Malayta Island, Solomon Islands.

Described from a large series of winged adults and soldiers collected with workers at the type locality by Dr. W. M. Mann, in May and June, 1916.

Type, soldier.—Cat. No. 15294, Museum of Comparative Zoology, Cambridge, Mass.; morphotype, winged adult; paratypes in U. S. National Museum.

Nasutitermes (*S.*) *orientis* is distinct in its hairy head, number and shape of antennal segments, and size.

Nasutitermes (*Subulitermes*) **orientis** Snyder, **tulagiensis**, new variety

Soldier.—Head light castaneous brown (yellow-brown, with greyish tinge), lighter near antennal sockets and posteriorly; head slightly constricted behind antennae, suboval, with few long hairs anteriorly and posteriorly and dense shorter hairs. Nasus light castaneous, with a reddish tinge, elongate, slender, cylindrical, slightly more robust at base (or more conical than in *orientis*); nasus with dense short hairs. Mandibles without points.

Antenna light yellow-brown with 11 segments; segments becoming longer and broader toward apex, with long hairs; third segment slender, subclavate, longer than second or fourth segments (when fourth is shorter than second segment), or approximately subequal to them; last segment slender, elongate and subelliptical.

Pronotum tinged with yellow (the anterior margin darker), saddle-shaped, with long hairs on anterior and short hairs on posterior margins.

Legs tinged with yellow, elongate, slender, with long hairs.

Abdomen dirty-white, tinged with yellow; tergites with a row of long hairs at base and other denser, shorter hairs; cerci fairly elongate, prominent.

Measurements.—Length of entire soldier, 2.5–3 mm.; length of head with nasus, 1.2–1.25 mm.; length of head without nasus (to anterior), 0.75 mm.; length of nasus, 0.45 mm.; length of pronotum, 0.12 mm.; length of hind tibia, 0.67 mm.; width of head (where widest, posteriorly), 0.7 mm.; width of pronotum, 0.37 mm.

Worker.—Length of post-clypeus less than half its breadth.

Type locality.—Tulagi Island, Solomon Islands.

Described from a large series of soldiers and workers collected by Dr. W. M. Mann at the type locality in May, 1916. Doctor Mann also collected soldiers, nymphs of the sexual form, and workers of this species of Ugi Island, Solomon Islands, in July and August, 1916. The antenna of these nymphs of the sexual form had 13 segments.

Type, soldier.—Cat. No. 15295, Museum of Comparative Zoology, Cambridge, Mass.; paratypes in U. S. National Museum.

This variety is slightly smaller than *orientis* and the third segment of the antenna is somewhat longer, but in most characters it is close to the typical form.

Nasutitermes (*Subulitermes*) **sanctae-crucis**, new species

Winged adult.—Head dark castaneous brown with reddish tinge, not much longer than broad, suboval, punctate, with dense, fairly long hairs and scattered longer hairs. Fontanelle as in *N.* (*S.*) *orientis* Snyder, but only the spot back of the ocelli hyaline.

Eyes black, not round, prominent, projecting, close to lateral margin of head. Ocelli hyaline, suboval, projecting, close to eye, separated from eyes by a distance less than their short diameter.

Antenna yellow-brown, with 13 segments, segments becoming longer and broader toward apex, with long hairs; third segment shorter than second or fourth; second longer than fourth; last segment slender, subelliptical.

Pronotum slightly lighter-colored than head, punctate; anterior margin nearly straight; posterior margin emarginate (not so strongly as in *orientis*); sides angularly narrowed posteriorly; hairs dense and long.

Wings smoky gray, the costal area darker (yellow-brown); tissue and margins of wing hairy; in fore wing, median vein parallel and close to cubitus, placed in middle of wing, branching to apex of wing, with 2 or 3 branches; cubitus below middle of wing, with 8–10 branches or subbranches to lower margin; hyaline area between median and cubitus.

Legs yellow-brown (the tibiae darker), elongate, slender, with long hairs.

Abdomen with tergites lighter-colored than head, with dense long hairs, the basal row longest; cerci short but prominent, the base stout.

Measurements.—Length of entire winged adult, 9.5–9.75 mm.; length of entire deälated adult, 5.5–6 mm.; length of head (to tip of labrum), 1.4 mm.; length of pronotum, 0.55 mm.; length of fore wing, 8 mm.; length of hind tibia, 1.15 mm.; diameter of eye (long diameter), 0.32 mm.; width of head (at eyes), 1.15 mm.; width of pronotum, 0.85 mm.; width of fore wing, 2.2–2.25 mm.

The winged sexual adult of *Nasutitermes* (*S.*) *sanctae-crucis*, unlike most oriental species of *Subulitermes*, has only 13 segments to the antennae.

Soldier.—Head light castaneous brown (yellow-brown with reddish tinge), lighter-colored at sides and anteriorly and posteriorly, slightly constricted in middle, pear-shaped, rounded posteriorly; head with nasus in

nearly a straight line, except for slight elevation at base of nasus; head with dense short hairs and 3–4 transverse rows of long hairs. Mandibles without points at apex.

Nasus darker-colored than head, castaneous with reddish tinge, cylindrical, slender, elongate, but not as long as length of head to base of mandibles, with short hairs.

Antenna yellow-brown, with 11 segments; segments becoming longer and broader toward apex, with long hairs; third segment subclavate, subequal to second or fourth segments, although sometimes longer than fourth and shorter than second; last segment slender, suboval.

Pronotum tinged with yellow (anterior margin darker), saddle-shaped, slightly emarginate anteriorly, with dense, short hairs and longer hairs on anterior margin.

Legs tinged with yellow, elongate, slender, with long hairs.

Abdomen with tergites tinged with yellow; tergites with dense long hairs, the row of hairs at the base of each being longest; cerci prominent.

Measurements.—Length of entire soldier, 2.6–2.9 mm.; length of head with nasus, 1.3–1.4 mm.; length of head without nasus ventrally (to anterior margin), 0.7–0.75 mm.; length of nasus, 0.6 mm.; length of pronotum, 1.5 mm.; length of hind tibiae, 0.7 mm.; width of head posteriorly (where widest) 0.7–0.75 mm.; width of pronotum, 0.36 mm.

Type locality.—Graciosa Bay, Santa Cruz Archipelago.

Described from a series of winged adults and soldiers collected with workers at the type locality by Dr. W. M. Mann in July, 1916.

Type, soldier.—Cat. No. 15296, Museum of Comparative Zoology, Cambridge, Mass., morphotype winged adult; paratype in the U. S. National Museum.

Nasutitermes (*S.*) *sanctae-crucis* has a longer nasus than *orientis* Snyder; unlike most oriental species of *Subulitermes* there are only 11 segments to the antenna and a very hairy head.

Genus *Microcerotermes* Silvestri

Species of the genus *Microcerotermes* are widely distributed throughout the tropics of the world. The West Indies and Central America represent their most northerly points of distribution, but their range extends to South America, Africa, Madagascar, Asia, New Guinea, Oceania generally, and Australia.

Over 55 species of *Microcerotermes* have been described, some of which are closely related and difficult to separate. These termites live in hard carton nests on trees, on the ground, and in colonies in wood; they are destructive wood borers.

Microcerotermes piliceps, new species

Soldier.—Head castaneous (red-brown), not twice as long as broad, cylindrical, the sides parallel (slightly concave in middle); head broadest posteriorly, narrowed anteriorly; posterior margin rounded; epicranial suture very steeply inclined anteriorly; head with dense, fairly long hairs. Fontanelle hyaline, small but distinct, raised, subelliptical, located at beginning of epicranial suture. Eye not distinct, on lower rim of depression

containing antennal socket. Gula at middle slightly less than half as broad as greatest anterior width. Labrum light yellow-brown, broader than long, subtriangular anteriorly, with long hairs.

Mandibles dark reddish-brown (lighter-colored at base), bowed or sabre shaped; in left mandible, bow 0.6 mm. deep (from inner margin to a line connecting apex and base); mandibles broad at base, narrowed and pointed at apex, where incurved, margins irregularly and coarsely serrate for basal two-thirds of their length.

Antenna yellow to light yellow-brown, with 13 segments; segments becoming broader toward apex, with long hairs; third segment half as long as second; fourth segment slightly shorter than second, last segment elongate, slender, subelliptical.

Pronotum light yellow-brown, saddle-shaped, shallowly and roundly concave medianly at anterior and posterior margins; sides gradually and roundly narrowed posteriorly, margins with dense long hairs.

Legs tinged with yellow, elongate, slender, with long hairs.

Abdomen tinged with yellow; tergites with dense long hairs; cerci not prominent.

Measurements.—Length of entire soldier, 5.3 mm. (shrunken?); length of head with mandibles, 2.7 mm.; length of head without mandibles (to anterior margin), 1.9 mm.; length of left mandible, 1.25 mm.; length of pronotum, 0.3 mm.; length of hind tibia, 0.9 mm.; width of head posteriorly, 1.2 mm.; width of head anteriorly, 1 mm.; height of head at middle, 1 mm.; width of pronotum, 0.75 mm.

Type locality.—Ugi Island, Solomon Islands.

Described from a large series of soldiers collected with workers at the type locality by Dr. W. M. Mann in July and August, 1916.

Type, soldier.—Cat. No. 15297, Museum of Comparative Zoology, Cambridge, Massachusetts; paratypes in United States National Museum.

Microcerotermes piliceps is distinctive on account of the densely hairy head of the soldier; *M. serrula* Desneux, from Borneo, is readily distinguished from *piliceps* by its smaller soldier, the head of which is less densely hairy; the soldier of *piliceps* also has a more hairy head than *M. annandalei* Silvestri, from Barkuda Island.

SCIENTIFIC NOTES AND NEWS

Dr. D. ROBERTS HARPER 3rd, physicist in the Bureau of Standards for more than sixteen years, has resigned to take charge of some heat measurements in the general engineering laboratory of the General Electric Company at Schenectady. Dr. HARPER has been stationed in New York for the past two years as the liaison officer of the Bureau of Standards with the American Engineering Standards Committee.

The degree of Doctor of Laws was recently conferred on Dr. CHARLES D. WALCOTT, Secretary of the Smithsonian Institution, by the University of the State of New York. This degree is conferred upon only one person each year, Secretary Walcott being the twelfth recipient of this honor.

Dr. S. F. BLAKE, of the Bureau of Plant Industry, returned early this month from Europe. Dr. Blake has been examining types of South American Compositae at the principal European herbaria.

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